1.4 Is Industrial and Territorial Ecology a Type of Social Innovation That is Able to Foster Territorial Development?

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Introduction

This paper aims at showing that industrial and territorial ecology can in some cases be considered a kind of social innovation. It is based on a presentation given at the ARL (Academy for Spatial Research and Planning) Summer School in August 2017 in Vienna (Austria) on "Social innovation in urban and regional development".

The notion of industrial ecology was mentioned for the first time in "L'écosystème Belgique. Essai d'écologie industrielle" (Billen et al., 1983). It advocates for adapting the production system of a linear economy, where resources are massively extracted from the biosphere and rejected as pollutants, to a more circular and unmaterialized economy, where non-renewable materials are marginally used to produce goods and services (Frosch and Gallopoulos, 1989). Industrial ecology seeks to analyse the metabolism of an industrial system in order to optimize incoming and outgoing material and energy streams (Buclet, 2015). Synergies that valorise underused resources are created between system actors, and this forms an efficient industrial ecosystem called 'industrial symbiosis', analogous to biological ecosystems. This ecosystem spans a geographic area with internal socio-natural processes and actors interacting in this space (Barles, 2014), which leads to the extensive concept of 'industrial and territorial ecology' (ITE).

ITE can be considered a form of social innovation. It can shape new territorial organisations, create collaborative relationships between stakeholders who are not used to cooperating and consequently generate benefits for industries, the environment, territories and society. In the first part of this paper, we look at how and under which

conditions the ITE concept is a form of social innovation. In the second part we present a case study of industrial district heating in Dunkirk (France), which is the result of a collaboration between public organisations, private companies and individuals. The last part draws conclusions regarding the concept of social innovation and how ITE can be an operational instrument facilitating local, regional, national and supra-national development for our industrial system. It gives concrete perspectives on 'how to put social innovation into action' through industrial symbiosis. This contribution can also serve as an introduction to a type of stakeholder who is usually hardly considered in social innovation theory: industries.

Industrial and territorial ecology is a kind of social innovation

A brief introduction to the social innovation concept

Despite the global economic growth and the development of new technologies in recent decades, socio-economic inequalities have increased (Klein et al., 2016a), socio-environmental fractures have worsened (Swyngedouw, 2009), social cohesion has weakened (Novy, 2013) and citizens' rights have been eroded (Castel, 2008). This is arguably a consequence of the financialization of economic activities, of higher flexibility and mobility of productive systems and of fiercer competitiveness. Additionally, the community seems unable to adapt to quick changes that affect our relationship to time, space and collectivity (Klein and Roy, 2013).

Social innovation (SI) experiments with new initiatives that can induce social transformations in the opposite way to the ones promoted by globalisation and neoliberalism and proposes a new development model that is more inclusive, sustainable, fair, participative and democratic (Moulaert et al., 2013; Klein, Laville and Moulaert, 2014).

According to his introduction he delivered at the summer school, Moulaert defines SI as a collective action that satisfies collective and/or individual needs and solves societal problems in order to pursue new or renewed human desires. These needs and problems are generally not or incorrectly managed by the institutional power in place (Klein and Harrison, 2007) and require innovative ideas in order to improve social conditions and people's well-being (Dawson and Daniel, 2010).

SI is a collective process that is socially constructed (Rammert, 2010). It is initiated by existing actors or constellations of actors that recombine to form new organisations (Howaldt, 2016). These organisations are characterised by innovative relationships and innovative practices. As Moulaert proposed in his introduction, any type of actor can lead a SI, from NGOs to local authorities or researchers. There is no restriction

regarding the origin of a SI and it can be conveyed through the market or through not-for-profit organisations (Howaldt, 2016). SI can also be triggered by other innovations from other sectors, be it the financial, organisational, technological, political or cultural sector (Castro-Spila and Unceta, 2016).

While they can greatly differ in origin, SIs have a well-defined perimeter and finality. By definition, they gather all the new experiences which are not strictly contained in the market or state sectors (Mulgan et al,. 2007). SI initiatives must emerge completely or partially outside of the normative practices that are conducted by the institutions in place. They have to foster social good, collective enrichment and solidarity (Klein et al., 2016b) and put the economics at the service of the people and of society (Bouchard, 2013).

Each individual innovation is very context-sensitive and cannot be the fruit of large policy planning. SIs are bottom-up initiatives, empowered locally by citizens acting near the problem's origin. This characteristic can make it very difficult to replicate initiatives unless local actions are linked to various networks, building new social links and facilitating collective learning. From this perspective, SI has strong macro-transforming potential and is able to pave the way for a massive implementation of similar initiatives. It has the capacity to build the base for a new development model, new organisations and institutions and new governance structures (Klein et al., 2016a).

This part provides a general definition of the SI concept based on definitions and characterisations gathered in the literature. The analysis of this large amount of references shows five recurring elements, which can be considered inherent characteristics of any SI:

1. Motivations: A SI is initiated in order to satisfy individual and/or collective needs and social problems that are not solved by the institutions in place.
2. Means: SIs are realised by innovative actions of various natures (financial, organisational, technical etc.). These actions challenge the practices dictated by the institutions in place.
3. Initiator: A SI is a collective process led by recombined (groups of) existing actors of various types within new organisations.
4. Finality: The final goal of SI is to improve the social conditions and well-being of people. Economic viability is a constraint and not a goal.
5. Perspectives: Through links and networking, SIs can be institutionalised and propose a new development model.

Characterisation of industrial and territorial ecology and comparison with social innovation

ITE engages traditionally separate stakeholders (industries, public authorities and communities) in a collective approach that leads to a competitive advantage. By

exchanging underused resources from an entity, which otherwise would have been discarded, to another these resources can be used as a substitute for new resources (Chertow, 2000; Deutz, 2014). Industrial facilities mainly seek to become more efficient, more competitive and more sustainable, while public authorities or communities will seek economic impetus, re-industrialisation and a better quality of life. Through a territorial development approach ITE pushes industrial processes to become intertwined.

Unlike SI, ITE does not necessarily look for a deep modification of the current economic paradigm as industries – the central ITE stakeholder – are mainly driven by monetary profit. The economic dimension is a key point because the performance of companies is ultimately evaluated against their accounting result. Nevertheless, these practices can be considered innovative as the economic driver is much less dominant than it is in traditional economic relationships. Synergies involve by-products or wastes with low or no economic value and without a dedicated market. This pushes organisations to find innovative business models that include new forms of values (social, environmental etc.) in order to create long-lasting synergies. The integrated whole must have an overall higher value (monetary or non-monetary, e.g. cheaper and more sustainable resource management, lower environmental impact, lower regulatory burden, reputation, work quality, community support and inclusion) than the sum of its initial parts, which were constraining, unwanted and without added value.

Consequently, ITE is a viable pathway to smoothly change the dominant un-sustainable paradigm of neoclassical economics (Korhonen et al., 2004) and improve the environmental efficiency of our global industrial system. The goal is not to drastically modify the industrial system but to find acceptable ways of improvement. The integration of the industrial subsystem into its parent ecosystem is already disrupting our economic paradigm, which still assumes an infinite source of raw materials (Chertow and Portlock, 2002).

The disruption intensity of ITE initiatives varies depending on the nature of the stakeholders involved in the negotiation. As ITE can build cooperative networks between private firms and public organisations (Korhonen et al., 2004), it offers the opportunity to internalise externalities and accede to new value sources. Some ITE externalities are:

- environmental (e.g. the reduction of raw material extraction, waste production and pollutant emission),
- social (e.g. new jobs and economic activities due to the synergy setup and exploitation, a decrease of chronic diseases, participatory planning, democratic decision-making processes and network management),
- territorial (e.g. local economic re-impetus of (de)industrialised territories, lower dependencies on fossil fuels and critical raw materials and high-skill attraction).

Like SI, ITE is a collaborative process that implies innovation in intra- and inter-business organisation. Internally, companies must voluntarily and fully integrate this

concept into their own global strategy and modify their working processes as well as their traditional contractual framework (Martinod et al., 2014). As ITE requires multi-disciplinary expertise (technical, legal, environmental etc.), the organisations also need to set up a dialogue between teams and trainings in order to gain new competences. But the main organisational innovations are inter-business-related. In essence, ITE links entities that are not used to collaborating together, that are unfamiliar with processes from other industrial sectors and do not even know their neighbouring organisations. The implementation of such a complex and unusual cooperation makes it necessary to create consensus through an inter-organisational confrontation of positions. It also requires an important mindset shift in decision-makers and the development of channels for sharing information.

The ITE concept can be compared to some extent to the SI concept as it proposes a new development model for industrial systems by opting out of the traditional business rules of established institutions and organisations (Alter, 2013). Here, competitive and market dynamics are softened, which opens collaborative relationships between industries and with other actors that are generally not included in business negotiations.

In general, ITE actors must remain independent from institutional and political dynamics in order to efficiently innovate. A case study literature review showed that the most successful initiatives are 'self-organised' as opposed to those that are state-planned or facilitated by third parties (public or private) (Boons et al., 2016). Klein et al. (2016a) identified the same success factor in the process of SI creation. The authors claim that it is necessary to let actors with a high level of autonomy to be able to reveal their innovative and creative potential.

Finally, the emancipation and development of the ITE concept relies on the cohesion between local initiatives (synergies). Putnam et al. (1993) introduced the concept of social capital that he defined as "features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions" (167), which is fully verified in this framework. Each individual synergy stakeholder gathers to collectively learn and access new resources (material, immaterial, informational etc.). When creating a dense synergy network – an industrial symbiosis – it will multiply the innovation potential and the potential for a deep social transformation.

Conditions for turning industrial and territorial ecology into social innovation

This section aims at clarifying whether ITE can be considered as a form of SI and if so under which conditions. To that end, we assess the ITE concept through the analysis grid of the five inherent criteria that characterise a SI.

Motivation

We observed that motivations and drivers can change depending on the actors involved in the synergies. However, industries, as public authorities, as well as communities both see ITE as an opportunity to solve problems and meet the needs that the current industrial system is not able to manage.

The basic needs of industries are to reduce costs, find new revenues and continue operating but the increasing market competitiveness and the constraining environmental regulations in Europe complicate meeting these needs. Companies have already optimised their processes substantially and fulfilled environmental requirements but today they have almost no more leverage to remain internationally competitive and to avoid shutting down sites due to unrealisable constraints. ITE appears as a great opportunity to create new values with underused resources, modernise plants and decrease pollutant emissions. Additionally, ITE can increase industry resilience and reduce supply and production risks by developing long-lasting and trusted relationships with various local partners. Such positive initiatives will improve relations with the neighbouring communities and can develop new ways of internal dynamisms.

ITE offers an operational solution for two main problems of European local and national authorities: (1) re-industrialising and/or keeping activities and jobs in the territory and (2) preserving community health by reducing pollutant emissions. The two complex issues are interconnected and a positive action for the former can be negative for the later. It has led to policy failures in the past decades but ITE presents an innovative way to solve these main territorial problems.

Similarly, citizens want to improve their living conditions and the quality of their environment but they also want to keep their jobs. ITE is an inclusive process that fosters knowledge-sharing between different kinds of stakeholders concerning territorial issues and opportunities. In some cases, the local population can get involved in decision-making and play a role in ITE.

Means

SIs are usually initiated by a mix of innovative actions divided into five central modes: technological, cultural, infrastructural, organisational and legal (Castro-Spila and Unceta, 2016). ITE clearly induces innovative actions from these modes which challenge 'business-as-usual' practices. Some examples are:

a) organisational: creating synergies between two or more stakeholders from different economic sectors; fostering dialogue and links between business departments; developing employees' ideation processes.
b) cultural: changing industrial decision-makers' behaviours and mindsets to create relationships out of core business activities and with almost no economic value and market.
c) technological: implementing new and emerging technologies in the existing industrial process to recover and treat waste materials or energy.

d) legal: creating new regulatory frameworks; modifying the waste status; elaborating new contractual frameworks.

Initiator

Synergies are created in a collective approach involving at least 2 stakeholders but generally more. The typology of actors is very wide and can include process industries, manufacturing companies, associations, local communities, farmers, national authorities, citizens etc.. The stakeholders gather to form new organisations called industrial ecosystems, which continue to evolve as such.

Finality

ITE is a concept that is able to generate a wide range of values. Some are internalised by companies but externalities remain and can be captured by the environment, the society or the territory. Depending on the type of synergy and the stakeholder leading the synergy, more or less externalities are produced with varying degrees of 'intentionality'. Synergies emerging out of businesses will probably have more economic than social or environmental motivations, and the reverse is likely to hold true for synergies emerging out of local authorities. Thus, in some cases the finality criterion will not be fulfilled as economic viability will be a goal. However, either way, when externalities are generated, they will efficiently foster well-being and improve social conditions.

Perspectives

We can already observe the institutionalisation of the ITE concept. A lot of governments already include it in their 'circular economy' regulation laws (e.g. China, France and Germany). Many subsidized projects are carried out in order to facilitate the creation of synergies, such as NISP in the United-Kingdom or Recyter in France. While it was anonymously created in certain independent places, the ITE concept has become famous in the academic, industrial and political worlds and is now modifying the industrial production model and inherently impacting our development model.

To conclude this part, according to criteria 1, 2, 3 and 5, an ITE can always be considered as a SI. It seeks to satisfy needs and solve problems of industries, public authorities and citizens through the creation of synergies, among other innovative practices. These synergies are far from business-as-usual relationships due to their low economic value, the unusual resource origin and their cooperative character. Today, the dissemination of the ITE concept across Europe and its social acceptation is noteworthy. It clearly participates in transforming the industrial model.

However, the 4th criterion prevents us from fully integrating the ITE concept into the SI concept. When led by industries (and sometimes by other stakeholders), the synergy motivation is often economic and not primarily focused on social development. This does not mean that social value is not created but due to the lack of 'intentionality' it is not possible to say that ITE initiatives are SIs in a universal sense.

A typical case of industrial territorial ecology as a social innovation

The North of France is a historic industrial cluster where many industries from various sectors are deeply rooted, and this situation favours the development of ITE initiatives. One of the most famous initiative was implemented in Dunkirk in 1985. It is a district heating network of 40 km fuelled by the excess heat from a neighbouring steel industry. It has grown over the years and today has an installed capacity of 100 MW, which heats an equivalent of 26.000 houses.

The synergy project was initiated at the end of the 1970s following the increase of crude oil prices and the economic crisis. The situation in the Dunkirk region became critical, with a high unemployment rate, a risk of heat scarcity and important pollution problems. The mayor, supported by local environmental associations, initiated a reflection to find solutions for improving the situation. As the excess heat sources were very important in the territory, he decided to start negotiating with one of the potential suppliers. Teams from the local authority and the steel plant agreed on an innovative solution – a kind of hood – based on a technology that was able to recover the heat from one of the industrial processes. They also agreed on the business models' details, which specified that the city invests in the installations but the industry engages in selling the heat at a very low price in order to be more competitive than housing individual gas boilers.

A second developmental step was launched in 2008. This was possible for two main reasons: (1) due to a law that decreases the VAT rate for district heating networks providing +50% with renewable energies and makes the heat prices more attractive and (2) due to an environmental regulation that forces the steel industry to decrease its dust emissions. Consequently, a second hood was implemented which increased the network installed capacity, and at the same time, enabled the capture of dusts that were polluting and disturbing the neighbouring communities. The network is still working, and an expansion project was launched during the last few years. The goal is to create a 'plug and play' network where industries with a heat surplus can provide the network with it and industries requiring heat can take heat from the network. Additionally and following this original project dynamic, an association (ECOPAL) was created for developing ITE initiatives in the Dunkirk region. It enabled the creation of about 10 synergies and brought together 100 stakeholders.

This case is an excellent example of how ITE can be considered a kind of SI. It brings together various stakeholders, with different typology: a process industry, the city of Dunkirk, an association, the private operator of the synergy, citizens, users of public buildings heated by the network (pools, schools, hospitals etc.) as well as regional, national and European authorities who subsidized the project. The synergy created a wide range of benefits shared among all stakeholders with an important social added value.

The needs and problems that initiated the synergy were diverse. The industry needed to reinforce its relationship with the neighbourhoods and reduce the dust emission. Dunkirk's mayor was motivated by his personal values, and as the community leader he wanted to fight against energy insecurity, reduce GHG emissions, increase renewable energies and be more independent from fossil fuels. The heat provider was able to create new local business and the consumers got reduced and controlled energy prices. By solving a complex societal problem with an innovative practice, ITE made it possible to improve the situation when traditional mechanisms were insufficient.

We can also observe how a first and isolated initiative triggered a massive development of the ITE concept within the region. Other similar initiatives emerged in the territory, and today the district heating network serves as a strong base for a new industrial model and for territorial development. This example reminds us that one individual SI – here an ITE initiative – can have a strong macro-transformative potential.

Conclusion

Based on the many definitions of SI in the scientific literature and discussed at the ARL summer school, this paper proposed 5 criteria that characterised a social innovation: the motivations, the means, the initiator, the finality and the perspective.

The ITE concept was assessed along this grid and showed that it is almost always compatible with the SI concept and that it can be considered as a type of SI. The partial incompatibility occurs when synergies are not primarily motivated by social considerations but by profit. However, economic benefits are inherent to any industry. Decision-makers will generally not invest in resources (financial, informational, human etc.) if they do not foresee an economic advantage. This statement leads to our first opening question: Do industries have a role to play in SI?

While the role of industries is hardly addressed in the scientific literature on SI, the Dunkirk case clearly illustrates the potential that industries have in addressing social and environmental problems through SI, more precisely through ITE initiatives. A wide range of social, environmental and territorial benefits are created and shared between stakeholders, including citizens and the community. This synergy also participates actively in the redevelopment of the Dunkirk region.

The Dunkirk case is characterised by the initial motivation of wishing to improve the social and environmental situation of the territory, whereas other ITE cases are less socially focused, such as Kalundborg (Denmark), the most famous case of industrial symbiosis. This symbiosis brings together a dozen of stakeholders who have shared more than 30 exchanges. While the synergies were mainly driven by economics in a competitive context, they needed to implement new practices between industries. They

had to strongly cooperate and share information, and in addition the whole symbiosis enabled the creation of a very strong industrial cluster that fosters territorial development while minimizing its impacts on the environment. In that sense, this symbiosis could also be considered as a form of SI, which leads to the second opening question: Is the condition of the 'non-economic driver' necessary to create SI?

In this paper we propose that any initiative can be considered a SI as far as social value is created, even if economic value creation was the primary initiating driver. This proposition makes it necessary to consider two SI approaches (analogous to the debates on sustainability domain): a 'strong' social innovation, with no initial focus on economics, and a 'weak' social innovation, in which economic gain as a driver is not an obstacle to solving societal problems. Initiatives from the first type would tend to completely challenge the current institutional practices and preach a drastic change of the societal paradigm, while initiatives of the second type would use the current economic system as a support to propose soft evolutions which are socially acceptable for the existing stakeholders.

This introductive work has shed light on both concepts of SI and ITE and more specifically on how ITE can be considered as a SI. Further research needs to be carried out in order to deeply understand what the social needs underpinning the creation of industrial synergies are and, to analyse in detail what the socially innovative practices in an ITE initiative are. It would also be interesting to investigate the role of industries in SI initiatives and whether indeed any stakeholder can lead a SI. And finally, this paper has identified two types of SI – strong and weak – depending on whether the initiative is primarily socially or primarily economically motivated. We hope that this proposition will lead to a new debate in the field of SI.

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